University of Saskatchewan
EP 155 – Electric and Magnetic Circuits
Midterm Examination #2

March 15, 2004

Time : 7:00-8:30 p.m.

Student's Name : (Print) _____

Student's Number: _____

Section (circle): **Section 2** (1:00-2:30 pm) **Section 4** (2:30-4:00 pm)

Notes :

A calculator and one $8\frac{1}{2} \times 11$ sheet of paper with notes on it are allowed

Please report the final answers in the boxes or spaces provided

Please show your work to convince the markers that you understand the material

The value for each partial question is indicated in parentheses

Please do not write on the back of a page, use extra pages provided

Marks for the exam (do not write in this space):

Q1:	Q4:
Q2:	Q5:
Q3:	Total:

Problem 1.

(a) For the circuit shown in Figure 1.1 the values of one resistor and one battery are not given. It is known that the voltage $\mathbf{V_a}$ = -22 V and the voltage $\mathbf{V_b}$ = -19 V. Provide the value of the resistor (**1 mark)**, the value of the voltage source including polarity **(2 marks)**. What is the voltage $\mathbf{V_{ca}}$? **(1 mark)**

Rx=	b) Battery voltage
c) Polarity as shown in Fig.1 or opposite (circle your answer)	d) V_{ca} =

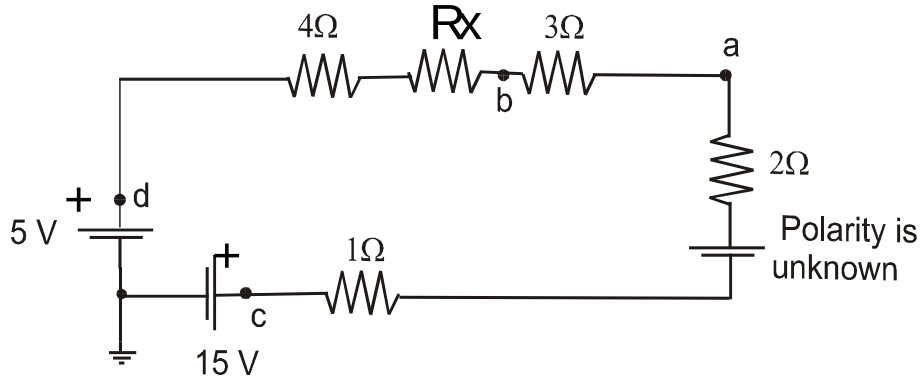


Figure 1.1:

(b) For the circuits shown in Figures 1.2 and 1.3 find the voltage $\mathbf{V_{ab}}$? **(2 marks each)**

Figure 1.2: V_{ab} =	**Figure 1.3:** V_{ab}=

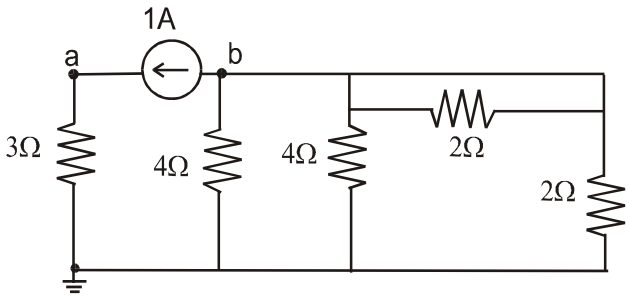


Figure 1.2

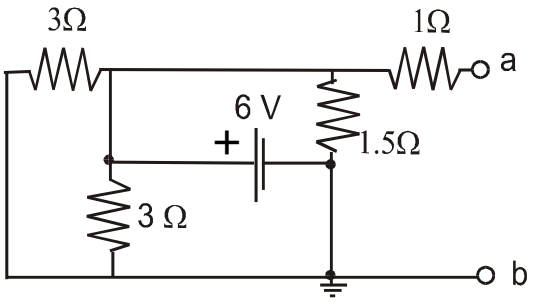


Figure 1.3

Problem 2. For the circuit shown in Figure 2.1:

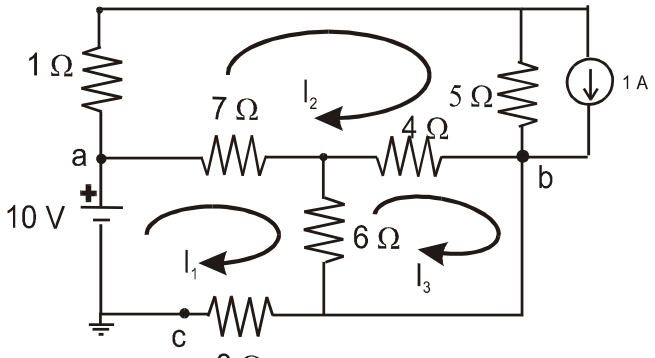


Figure 2.1:

a) Write the loop equations in the matrix form **(3 marks)**

$$\begin{pmatrix} \cdots & \cdots & \cdots \\ \cdots & \cdots & \cdots \\ \cdots & \cdots & \cdots \end{pmatrix} \begin{pmatrix} I_1 \\ I_2 \\ I_3 \end{pmatrix} = \begin{pmatrix} \cdots \\ \cdots \\ \cdots \end{pmatrix}$$

b) If the current I_2 is 0.9 A, what is the voltage of point **b**? **(2 marks)**

c) How much work needs to be done to move a negative charge of –1C from point **c** to point **a**? **(2 marks)**

V_b =	Work=

Problem 3.

Two circuit diagrams for simple analog meters (constructed with two identical meter movements) are shown in Figures 3.1 and 3.2.

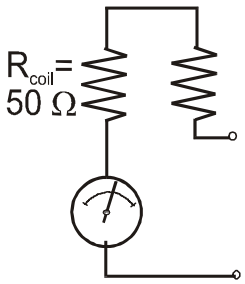


Figure 3.1

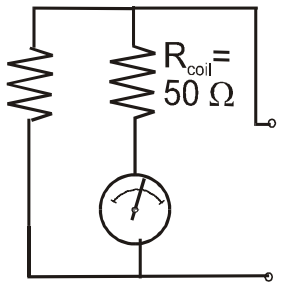


Figure 3.2

a) Which of Figures 3.1 and 3.2 is the voltmeter? _____ **(1 mark)**

The voltmeter has been designed to measure a maximum of **10 V** while the ammeter was designed to measure a maximum of **100 mA**. The full-scale deflection current associated with the meter movement is **1 mA**.

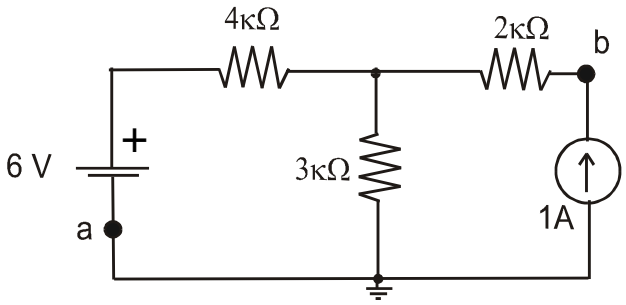
b) What is the additional resistance of the voltmeter? _____ **(2 marks)**

c) What is the additional resistance of the ammeter? _____ **(2 marks)**

d) Assume that a completely different voltmeter with the total resistance of 10 kΩ is connected to the circuit shown in Figure 3.3 with the correct polarity to measure the voltage between points **a** and **b**. What does it read?

V_{ab} : _____ **(2 marks)**

Figure 3.3:



Problem 4.

For the circuit of Figures 4.1 (this is the same as a home assignment problem) find

a) the total resistance as seen by the source **(2 marks)**
b) the currents through the 10-Ω resistor **(2 marks)**
c) the voltage across the 24-Ω resistor **(2 marks)**

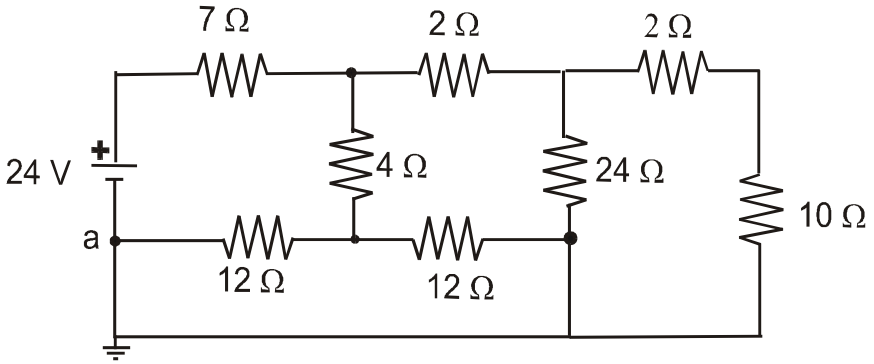


Figure 4.1:

R_{tot}=	$I_{10\Omega}$=	$V_{24\Omega}$=

Problem 5. Using superposition (Figure 5), find

a) the current through the 3-Ω resistor due to the voltage source **(2 marks)**
b) the current through the 3-Ω resistor due to the current source **(2 marks)**
c) the power delivered to the 3-Ω resistor **(2 marks)**
d) the voltage V_{ab} **(2 marks)**

$I_{3\Omega}$(volt.source)=	$I_{3\Omega}$(curr.source)=	$P_{3\Omega}$=
Direction: Left or right (circle your answer)	Direction: Left or right (circle your answer)	Voltage V_{ab}=

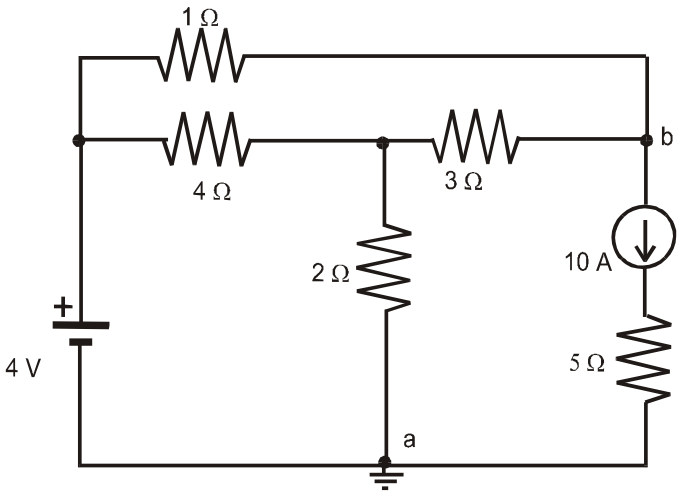


Figure 5: